

AMERICAN POLAR SOCIETY

80th ANNIVERSARY MEETING AND SYMPOSIUM

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THE POLAR OCEANS and GLOBAL CLIMATE CHANGE

Tuesday, November 3 – Friday, November 6, 2015

Seaside Forum

Scripps Institution of Oceanography

UC San Diego, La Jolla

Climate change in the past several decades has been apparent in many locations around the world, but nowhere else has it become more evident than in the polar regions. In the Arctic, rising temperatures, melting glaciers, thawing permafrost, retreating sea-ice cover, and bubbling methane releases are already impinging on native Arctic cultures and numerous species, from microscopic organisms living within the ice to the massive walrus and majestic polar bear. In the Antarctic, significant decay of the gigantic Antarctic ice sheet, disintegration of the ice shelves, and the retreat of grounding lines (the point from which glaciers float seaward), assisted by warming ocean waters, could just be precursors of what is to come.

The Arctic Ocean comprises 4-5 percent of the Earth's oceans, and the Southern Ocean below the Antarctic Convergence (the zone encircling Antarctica) represents 10 percent. Some 15 percent of the saline water in the planet's hydrosphere is therefore located at the top and bottom of the world. Seals, whales, and a teeming variety of avian species proliferate in these unique biospheres. The nature of the polar seas and their influence on local and temperate latitudes have been traditional objects of study going back to the "heroic age" of polar exploration in the 19th and 20th centuries. In the context of current climate change, the linkages are becoming alarmingly evident. The Arctic and Antarctic are destined, therefore, to be among the key regions for the scientific study of global climate change. Fieldwork, aided by further advances in technological capability, will be instrumental in helping the world's scientists and policymakers

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF CHEMISTRY

REPORT OF THE COMMITTEE ON THE PROGRESS OF THE DEPARTMENT

FOR THE YEAR 1900-1901

PRESENTED TO THE FACULTY

AT THE MEETING OF THE FACULTY HELD AT CHICAGO, ILL.,

ON THE 15TH DAY OF JANUARY, 1901

BY THE COMMITTEE

JOHN D. COLEMAN, Chairman

WILLIAM B. BAKER, Secretary

ALFRED C. COLEMAN, Member

JOHN D. COLEMAN, Member

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come to grips with the earth's changing climate cycles, limited only by the thoughtfulness of the questions that are posed.

In commemoration of its 80th anniversary, the American Polar Society (APS) is joining with the Scripps Institution of Oceanography to bring together world-class leaders in science and diplomacy to discuss the role of polar oceans in global climate change. This is a landmark in the APS's history and the most authoritative forum yet held on a topic of critical importance.

SPEAKERS' SUMMARIES & BIOGRAPHIES

DAVID G. AINLEY, Senior Ecological Associate, H.T. Harvey and Associates, San Jose, CA, and Adjunct Professor, Moss Landing Marine Laboratories, Moss Landing, CA

TITLE: *"Adélie Penguins Adapt to a Changing Ross Sea Climate and Food Web"*

SUMMARY: One of the longest biological time series in the Antarctic is that of changing colony size of Adélie penguins in the Ross Sea, with annual data for some colonies existing since the late 1950s. The Adélie penguin is a sea-ice obligate species, found nowhere that sea ice does not exist for at least part of the year, although it is a love-hate relationship with sea ice (too little, too much). In the modern era, penguins at these colonies have coped with decadal variability in wind and sea-ice patterns, mega-iceberg calving that rearranged sea ice, the depletion and then recovery of cetacean trophic competitors, and more recently depletion of another competitor, the Antarctic toothfish. Moreover, the presence/absence of some of these colonies through the last glaciation has been well investigated on the basis of subfossil bones and dietary remains left in ancient guano deposits, thus providing insight into penguin response to ice shelf advance and retreat. To say the least, the Adélie penguin, and especially those in the Ross Sea (33 percent of world population), qualify as an "indicator species extraordinaire" in the context of gauging biotic response to environmental change in the Antarctic.

BIO: David Ainley, Senior Ecological Associate, H.T. Harvey and Associates, has studied all aspects of marine ecosystems for more than 40 years. He has made ~35 trips to Antarctica and the Southern Ocean, about half on oceanographic research vessels. He is founder of FORSE (Friends of the Ross Sea Ecosystem), an assemblage of Ross Sea scientists, and co-founder of Last Ocean Trust, both organizations dedicated to conserving the Ross Sea and designating it as a Marine Protected Area. Ainley holds a B.S. degree in biology from Dickinson College and a Ph.D. in animal behavior/ecology from Johns Hopkins University. He is currently involved in research on penguin demography and marine ecology around Ross Island, including studies on the effects of cetacean and penguin foraging on prey availability using ocean gliders and ROVs to assess abundance as well as response of the prey to the predators. He has also worked extensively in the California Current, including many cruises, as well as founding, and then

working at, the Point Blue Conservation Science (formerly PRBO) marine research program on the Farallon Islands. He has written four books, 12 monographs and ~230 papers about the ecology of marine top predators: seabirds, mammals and sharks, half of those contributions derived from Antarctic research. He played a large role in producing the award-winning film, “The Last Ocean,” and in developing the educational PenguinScience website, which receives >2M hits per year.

NORMAN R. AUGUSTINE, Retired Chairman and Chief Executive Officer, Lockheed Martin Corporation

TITLE: “*The Science of Climate Change—and the Change in the Climate of Science*”

SUMMARY: Science leads the way in assessing climate change on our planet. Furthermore, science in the Southern Ocean is a key element in our overall understanding of climate change throughout the world. Scientific research conducted in the Southern Ocean and on the Antarctic Continent has already had a profound impact on many fields, and itself benefits from the explosion of knowledge that is taking place in disciplines ranging from genomics to nanotechnology to robotics to large-scale computing. Yet, at this very time, America is disinvesting in science—a practice that will need to be reversed if science is to continue to lead the way in meeting many of the world’s great challenges, particularly with regard to such existential matters as climate change.

BIO: Norman Augustine is the retired Chairman and Chief Executive Officer of Lockheed Martin Corporation, the nation’s largest defense contractor, and a former Undersecretary of the Army. As former Chair of the National Academy of Engineering, Augustine recently led a strategic U.S. Antarctic Program Blue Ribbon Panel to assess U.S. science-support operations on the continent of Antarctica and the Southern Ocean. He has previously served on the President’s Council of Advisors on Science and Technology during both Democratic and Republican administrations, leading the last such review in 1997. He has also led a number of other high-profile commissions and panels regarding national priorities in science and technology domains. As former Chair of the National Academy of Engineering, in 2009 he was named chairman of the Review of the United States Human Space Flight Plans Committee that was tasked to review NASA’s plans for the moon, Mars, and beyond. Augustine is an avid outdoors enthusiast who has trekked extensively around the world, including dogsledding in the Arctic, exploring volcanoes in Antarctica, canoeing the Boundary Waters of Canada, and snorkeling on the Great Barrier Reef. He has stood on both poles of the Earth. He attended Princeton University, earning a B.S.E. in aeronautical engineering, magna cum laude, in 1957. He holds eighteen honorary degrees and is the author of *Augustine’s Travels*; *The Defense Revolution*; and *Augustine’s Laws*. Augustine is a member of the American Philosophical Society, the National Academy of Arts and Sciences, and The Explorers Club. Among his many awards and honors received over the years is the National Medal of Technology by the President of the United States, the Joint Chiefs of Staff Distinguished Public Service Award, and the U.S. Department of Defense’s Civilian

Distinguished Service Medal. He has served as Chair of the American Red Cross and President of the Boy Scouts of America.

CECILIA M. BITZ, Professor, Atmospheric Sciences Department, University of Washington

TITLE: *"Modeling the Future of Sea Ice in the Polar Oceans"*

SUMMARY: The climate has warmed since pre-industrial times, according to numerous independent lines of evidence. Significant long-term warming is seen on nearly every continent and in nearly every ocean basin, and the change has been attributed primarily to greenhouse gas emissions from burning fossil fuels and land-use change. However, the sea-ice changes in the satellite record are not in agreement across the hemispheres. Arctic sea-ice extent has declined in every season, with a maximum decline in late summer. On the other hand, Antarctic sea-ice extent has certainly not decreased significantly, and may even have slightly increased. Bitz will discuss what is known about this dichotomy in the behavior of sea ice across the hemispheres from a global modeling perspective. Sea ice strongly influences climate feedbacks that globalize the impact of sea ice. The feedbacks from the opposing poles will be compared and contrasted and their consequences for global climate discussed in light of the hemispheric asymmetry in sea-ice change. Model projections show that sea-ice loss and surface warming in the Southern Ocean will remain far behind changes in the Arctic through the end of the 21st century.

BIO: Cecilia Bitz, Professor of Atmospheric Sciences Department at the University of Washington, is also part of the university's Program on Climate Change and the Future of Ice Initiative, with a research focus on ice and climate interactions, especially involving sea ice. Her research group is actively investigating Arctic sea-ice predictability. She co-leads the Sea Ice Prediction Network, which manages the SEARCH Sea Ice Outlook, and the Polar Climate Prediction Initiative of the World Climate Research Program. This year she testified before the U.S. Senate Energy and Natural Resources Committee on Arctic climate change. She is an active volunteer and science advisor to Polar Bears International, also winning the 2013 Rosenstiel award for Oceanography and Meteorology and the 2013 Ascent award for the Atmospheric Sciences section of the American Geophysical Union. She was Agassiz Visiting Lecturer at Harvard University in 2013, among other recent lectureships. Bitz graduated from Oregon State University with a B.Sc. in engineering physics in 1988. She holds an M.S. degree in physics (1990) and a Ph.D. in atmospheric science (1997), both from the University of Washington, where she has spent most of her professional career. In 2013-14, Bitz was a Fulbright Senior Scholar to New Zealand, during which time she did field work in Antarctica. She is the principal author or co-author of upwards of 100 refereed and non-refereed publications and reports. Apart from her service and teaching at the University of Washington, her professional service includes most recently membership on the Advisory Committee for the National Science Foundation's Office of Polar Programs; the Committee on "Linkages between Arctic Warming and Mid-

Latitude Weather Patterns”; the Advisory Board of the Community Climate System Model; and a panel of the National Research Council workshop on “Sea Ice Prediction.”

LAWSON W. BRIGHAM, Distinguished Professor of Geography and Arctic Policy, University of Alaska Fairbanks; Senior Fellow, Institute of the North; former Chair of the Arctic Council’s Arctic Marine Shipping Assessment, and Vice Chair of the Council’s working group on Protection of the Arctic Marine Environment.

TITLE: *“The New Maritime Arctic: Strategies for Marine Use and Protection”*

SUMMARY: Globalization (the linkages of Arctic natural resources to global markets) and climate change (the retreat of Arctic sea ice) are changing the maritime Arctic in unprecedented ways. Profound Arctic sea-ice changes provide for greater marine access throughout the Arctic Ocean and potentially longer seasons of navigation. Arctic natural resource developments, offshore and onshore, are driving the need for safe and reliable marine transportation systems and for investments in a wide range of infrastructure. The Arctic Council has addressed marine safety and environmental protection issues in its Arctic Marine Shipping Assessment (2009) and Arctic Marine Strategic Plan (2015). The International Maritime Organization has developed a new Polar Code for ships operating in polar waters that will come into force on 1 January 2017. Implementation of the Polar Code will involve the flag states, Arctic states, ship classification societies, marine insurance industry, and a host of other stakeholders and actors. However, the Polar Code focuses only on large commercial carriers and passenger vessels (all 500 tons or more) and their required ship’s structure, marine safety equipment, crew training, and environmental rules (for the discharge of oil, noxious liquids, sewage and garbage). These new rules and regulations will be expanded in the future to address such issues as black carbon emissions; creating an Arctic emissions control area; establishing marine protected areas; and including smaller vessels such as tugs and barges and fishing vessels under limited international regulation. While the primary focus of these efforts will be to enhance the safety and protection of Arctic peoples and the marine environment, future unified strategies will balance the need to facilitate marine use in this newly accessible marine space.

BIO: A Fellow of the U.S. Coast Guard Academy’s Center for Arctic Study & Policy, Lawson Brigham is a former U.S. Coast Guard officer who commanded four Coast Guard cutters including the polar icebreaker *Polar Sea* on Arctic and Antarctic expeditions. During 2004-09 he was Chair of the Arctic Council’s Arctic Marine Shipping Assessment and Vice Chair of the Council’s working group on Protection of the Arctic Marine Environment. Captain Brigham has been a research fellow at Woods Hole Oceanographic Institution, a faculty member of the U.S. Coast Guard Academy and the Naval Postgraduate School, and Alaska Director of the U.S. Arctic Research Commission. He received a B.S. degree from the U.S. Coast Guard Academy and is a U.S. Naval War College distinguished graduate, holding an M.S. degree from Rensselaer

Polytechnic Institute and an M.Phil. and Ph.D. from the University of Cambridge. His research interests have focused on the Russian maritime Arctic, Arctic climate change and futures, polar marine transportation, and polar geopolitics. Brigham was a 2008 signer of the American Geographical Society's Flier's and Explorer's Globe and the Society's historic globe of exploration, in recognition of 1994 voyages of the *Polar Sea*, the first ship in history to reach the extreme ends of the global ocean. He is a member of the Council on Foreign Relations and the World Economic Forum's Global Agenda Council on the Arctic and was recently selected as a member of the Norwegian Scientific Academy for Polar Research.

ANNE L. DOUBILET, Underwater explorer, writer, photographer

TITLE: *"From the Ends of the Earth: The Arctic and Antarctic"*

SUMMARY: Video presentation of polar images by Anne L. Doubilet (www.annedoubilet.com), featuring original music compositions by Garth Stevenson (www.garthstevenson.com) from his DVD *Flying*, both inspired by the crystalline polar air, light and ice. Doubilet will be photographing representative scenes and individuals at the symposium, to be published with an account of the symposium in the January 2016 issue of *The Polar Times*. Her video presentation will be shown in the lobby and auditorium of Seaside Forum.

BIO: Anne Doubilet has logged thousands of dives worldwide as a freelance photographer and dive-team member for *National Geographic* magazine, contributing to 27 stories on the seas. A member of the Women Divers Hall of Fame, Doubilet has worked under water in the Red Sea, Papua New Guinea, Palau, Hawaii, Fiji, Tahiti, Indonesia, Madagascar, Japan, the Galapagos, all around Australia's coasts, throughout the Caribbean, and on land in the Arctic and Antarctic. A Fellow of The Explorers Club, she has served on its Board of Directors. She is now a Board Director of the new Explorers Museum, whose mission is to "Explore, Discover, Preserve, Sustain and Share." To promote clean ocean awareness, she created *annedoubiletphoto EcoCuffs®*, a successful line of bracelets imprinted on recycled aluminum with her original underwater photos and with percentage of sales donated to ocean nonprofits. Lecturing at national and international venues, she is represented by the World Explorers Bureau, speaking to the issue of oceans in peril as seen through her 40 years of working under water.

JULIAN A. DOWDESWELL, Professor of Physical Geography and Director, Scott Polar Research Institute, University of Cambridge

TITLE: *"The Marine Geological Record of Past Ice-sheet Growth and Decay"*

SUMMARY: The deglaciation of high-latitude continental shelves since the Last Glacial Maximum has revealed suites of subglacial and ice-contact landforms that have remained well-preserved beneath tens to hundreds of meters of water. Once ice has retreated, sedimentation is generally low on polar shelves during interglacials, and the submarine landforms have not, therefore, been buried by subsequent sedimentation. By contrast, the beds of modern ice sheets are hidden by several thousand meters of ice, which is much more difficult than water to penetrate using geophysical methods. These submarine glacial landforms provide insights into past ice-sheet form and flow and into the processes that have taken place beneath former ice sheets. Examples are given of streamlined subglacial landforms that indicate the distribution and dimensions of former ice streams on the Norwegian and Antarctic continental margins. Distinctive landform assemblages characterize ice stream and inter-ice stream areas. Landforms, including subglacially formed channel systems in inner- and mid-shelf areas, and the lack of them on sedimentary outer shelves, allow inferences to be made about subglacial hydrology. The distribution of grounding-zone wedges and other transverse moraine ridges also provides evidence on the nature of ice-sheet retreat, whether by rapid collapse or episodic retreat or by the slow retreat of grounded ice. Such information can be used to test the predictive capability of ice-sheet numerical models. Marine geophysical and geological observations of submarine glacial landforms enhance our understanding of the form and flow of past ice masses at scales, ranging from ice sheets (1000s of km in flow-line and margin length), through ice streams (100s of km long), to surge-type glaciers (10s of km long).

BIO: Julian Dowdeswell has been Professor of Physical Geography and Director of the Scott Polar Research Institute in the University of Cambridge since 2002. He is also Brian Buckley Fellow in Polar Science at Jesus College, Cambridge. Julian graduated from the University of Cambridge with first-class honors and studied for a master's degree at the University of Colorado before returning to Cambridge for his doctorate. He has research interests in glaciology and glacial geology, working on the form and flow of glaciers and ice caps and their response to climate change and on the links between former ice sheets and the marine-geological record, using a variety of satellite, airborne and shipborne geophysical instruments. He has worked in many parts of the Arctic, including the Canadian North, Greenland, Iceland, Svalbard and the Russian Arctic islands, together with the Norwegian-Greenland Sea, the Barents Sea and Baffin Bay, and also in Antarctica, in a series of field-research projects over the past 30 years. He has written more than 250 scientific papers and eight books. Dowdeswell has been awarded the Polar Medal by Her Majesty the Queen for "outstanding contributions to glacier geophysics" and received the Founder's Gold Medal from the Royal Geographical Society. In 2011 he was awarded the Louis Agassiz Medal by the European Geosciences Union for "outstanding contributions to the study of polar ice masses and to the understanding of the processes and patterns of sedimentation in glacier-influenced marine environments." In 2014 he was awarded the IASC Medal of the International Arctic Science Committee.

SYLVIA A. EARLE, Oceanographer, ocean advocate, Explorer-in-Residence, National Geographic Society, and Founder, Mission Blue and SEAlliance

TITLE: “*Exploring and Protecting Polar Oceans*”

BIO: Called *Her Deepness* by the *New Yorker* magazine and the *New York Times*, *Living Legend* by the Library of Congress, and first *Hero for the Planet* by *Time* magazine, Sylvia Earle is an oceanographer, explorer, author and lecturer with experience as a field research scientist, government official, and director for corporate and nonprofit organizations including the Kerr McGee Corporation, Dresser Industries, Oryx Energy, the Aspen Institute, the Conservation Fund, American Rivers, Mote Marine Laboratory, Duke University Marine Laboratory (Beaufort, NC), Rutgers Institute for Marine Science, the Woods Hole Oceanographic Institution, Conservation International, the World Wildlife Fund US and International, National Marine Sanctuary Foundation, and Ocean Futures. Appointed as an Ocean Elder, Patron of the International Union for Conservation of Nature, and ARKive, she is a National Geographic Society (NGS) Explorer-in-Residence, founder of Deep Ocean Exploration and Research, Inc., founder of Mission Blue and SEAlliance, Chair of the Advisory Council of the Harte Research Institute, the Ocean in Google Earth, leader of the NGS Sustainable Seas Expeditions, and formerly Chief Scientist of the U.S. National Oceanographic and Atmospheric Administration. She has a B.S. degree from Florida State University, an M.S. and Ph.D. from Duke University, and 26 honorary degrees, authoring more than 200 scientific, technical and popular publications. She has led more than 100 expeditions and logged more than 7000 hours under water, leading the first team of women aquanauts during the Tektite Project in 1970 and participating in ten saturation dives, most recently in July 2012. Her research concerns marine ecosystems with special reference to exploration, conservation and the development and use of new technologies for access and effective operations in the deep sea and other remote environments. Her special focus is on developing a global network of areas on the land and in the ocean, “Hope Spots,” to safeguard the living systems that provide the underpinnings of global processes, from maintaining biodiversity and yielding basic life support services to providing stability and resiliency in response to climate change. Earle has received more than 100 national and international honors, including the TED Prize in 2009, the Royal Geographical Society Patrons Medal and the Medal of Honor from the Dominican Republic in 2011, the National Geographic Hubbard Medal in 2013, the Walter Cronkite Leadership Award and the United Nations Environment Programmer’s Champion of the Earth award in 2014. Other honors are Australia’s International Banksia Award, Italy’s Artiglio Award, the International Seakeepers Award, the National Women’s Hall of Fame, and the Los Angeles *Times* Woman of the Year. She has received additional medals from The Explorers Club, the Philadelphia Academy of Sciences, the Lindbergh Foundation, the National Wildlife Federation, Sigma Xi, Barnard College, and the Society of Woman Geographers.

KELLY K. FALKNER, Division Director, Division of Polar Programs, National Science Foundation (NSF)

TITLE: *“What’s New in Polar Programs at NSF”*

SUMMARY: The talk will provide an overview of polar programs at the U.S. National Science Foundation and include highlights from current polar research and logistics sponsored by the NSF.

BIO: In addition to her current position as Division Director, Division of Polar Programs at the National Science Foundation, Kelly Falkner is a Director of the U.S. Antarctic Program, which the NSF manages on behalf of the U.S. government in accordance with Presidential Memorandum 6626 and the terms of the Antarctic Treaty System. A member of the Senior Executive Service, she oversees an annual budget of about \$450 million covering scientific research and logistics programs in both the Arctic and Antarctic. She joined the NSF in 2010 as Deputy Director of the Office of Polar Programs and transitioned to Director of the Division in 2012. During the International Polar Year (2007-08), she undertook a two-year NSF Intergovernmental Personnel Act assignment as the founding Director for the Antarctic Integrated System Science Program. Prior to federal service, she was Professor in the College of Oceanic & Atmospheric Sciences at Oregon State University where she taught and conducted research. As a sea-going oceanographer for 30 years, she has traveled all over the world from two miles below the sea surface, to Lake Baikal, the Greenland Ice Cap, the Black Sea and the world’s oceans. Over 20 years she has led field research in the Arctic, serving as a member of the North Pole Environmental Observatory as well as Chief Scientist on multiple icebreaking and aircraft-based expeditions. She and her team executed state-of-the-art chemical measurements to investigate a wide array of environmental topics, the results of which are presented in more than 60 peer-reviewed journal articles and book chapters. She is the recipient of an NSF Graduate Fellowship (1984-87), Association of Women in Science Pre-Doctoral Award (1987), Office of Naval Research Young Investigator Award (1993-95), Oregon State University Student Mentoring Award (2000) and NSF Arctic Service Medal (2000). An associate editor for *Cosmochimica Geochimica Acta* (2002-06), she has served on numerous university, national and international committees. She conducted postdoctoral studies at the Massachusetts Institute of Technology in 1990 under an NSF Women’s Initiation Award and at the Centre National d’Etudes Spatiales in Toulouse, France, in 1990-92 under a NATO Postdoctoral Fellowship and CNES Poste Rouge, respectively. She earned a B.A. degree in chemistry with a minor in Russian studies from Reed College with Phi Beta Kappa distinction in 1983 and a Ph.D. in chemical oceanography from the Woods Hole Oceanographic Institution-MIT Joint Program in Oceanography in 1989.

JACQUELINE M. GREBMEIER, Research Professor, University of Maryland Center for Environmental Science

TITLE: *“Marine Ecosystem Responses to Ongoing Environmental Changes in the Arctic”*

SUMMARY: This presentation will highlight key findings arising from the study of biological responses to environmental change across the Arctic, with a focus on case studies from the Pacific Arctic region. Seasonal and inter-annual changes in sea-ice extent, duration and seawater temperature influence biological processes and ecosystem dynamics in the Arctic. Biological patterns and responses at persistent high benthic biomass patches can be termed “hotspots.” These biological concentrations respond to physical forcing and can provide insights into how ecosystems are responding to ongoing environmental change in the Arctic. We are now relating distribution shifts of organisms, from small benthic prey to migrating seabird and marine mammal benthivores, to changes in sea-ice conditions, warming seawater, and the changing phenology of key ecosystem processes. Observations on a decadal scale are providing insights into the status of biological marine systems as they respond to advective shifts on the Arctic shelves. We are also significantly improving our understanding of the connectivity of trophic components within the food web. Repeated sampling on both temporal and spatial scales is facilitating the evaluation of the seasonality of ecosystem status and trends. The Distributed Biological Observatory, an internationally developed marine observing system, is currently focused in the Pacific Arctic but is being used as a model for expansion to the pan-Arctic scale and is endorsed by multiple international science organizations.

BIO: Jacqueline Grebmeier is a biological oceanographer and Research Professor at the University of Maryland Center for Environmental Science. Her research focuses on understanding how arctic marine ecosystems respond to environmental change, particularly on efforts to illuminate the importance of benthic biological systems. She has conducted studies of pelagic-benthic coupling in marine systems, benthic carbon cycling, benthic faunal population structure, and polar ecosystem health. She earned a B.A degree in zoology from the University of California, Davis, in 1977 and masters’ degrees in biology from Stanford University in 1979 and in marine affairs from the University of Washington in 1983, specializing in applications of Arctic science to Arctic policy. Her Ph.D. in biological oceanography was received from the University of Alaska Fairbanks in 1987. She has played a leadership role in coordinating and promoting national and international Arctic research. Recently completing her service as the U.S. delegate to, and a vice-president of, the International Arctic Science Committee and as a member of the U.S. Polar Research Board of the National Academies, she also formerly served as a Commissioner of the U.S. Arctic Research Commission following appointment by President Clinton. She has contributed to other coordinated international and national science planning efforts including service on the steering committee for U.S. efforts during the International Polar Year. Over the past 30 years, she has participated in more than 45 oceanographic expeditions on both U.S. and foreign vessels, many as chief scientist and was the overall project lead scientist for the U.S. Western Arctic Shelf-Basin Interactions project, which was one of the largest U.S.-funded global change studies undertaken in the Arctic. She has published approximately 100 peer-reviewed scientific papers and has also served as editor of several books and journal special issues.

JAMES E. HANSEN, Adjunct Professor, Climate Science, Awareness and Solutions Program, Earth Institute, Columbia University

TITLE: *“Ice, Polar Oceans, and Sea Level: Interpretation of Paleo and Modern Data and Possible Issues about Models”*

SUMMARY: The presentation will discuss data and models related to the stability of ice sheets and sea level. The focus will be on issues concerning the ability of models, ocean models and ice sheet models to simulate real-world responses to anthropogenic climate forcings.

BIO: James Hansen, formerly Director of the National Aeronautics and Space Administration’s Goddard Institute for Space Studies (NASA GISS), is currently Adjunct Professor at Columbia University’s Earth Institute, where he directs the Climate Science, Awareness and Solutions program. He was trained in physics and astronomy in the space science program of James Van Allen at the University of Iowa, receiving a B.A. degree with highest distinction in physics and mathematics and an M.A. in astronomy. In 1965-66 he was a visiting student at the Institute of Astrophysics, University of Kyoto and the Department of Astronomy, Tokyo University, receiving his Ph.D. in physics from the University of Iowa in 1967. Except for 1969, when he was a National Science Foundation postdoctoral scientist at Leiden Observatory under Professor H. C. van de Hulst, he has spent his postdoctoral career at NASA GISS. In his early research he used telescopic observations of Venus to extract detailed information on the physical properties of the cloud and haze particles that veil Venus. Since the mid-1970s, he has focused on studies and computer simulations of the Earth’s climate for the purpose of understanding the human impact on global climate. He is best known for his testimony on climate change to the U.S. Congress in the 1980s that helped raise broad awareness of global warming. In recent years he has drawn attention to the danger of passing climate tipping points, producing irreversible climate impacts that would yield a different planet from the one on which civilization developed and outlined steps that are needed to stabilize climate with a cleaner atmosphere and ocean. Elected to the National Academy of Sciences in 1995, he was given both the Heinz Award for environment and the American Geophysical Union’s Roger Revelle Medal in 2001. He received the World Wildlife Federation’s Conservation Medal from the Duke of Edinburgh in 2006; the Dan David Prize in the field of Quest for Energy, the Leo Szilard Award of the American Physical Society for Use of Physics for the Benefit of Society, and the American Association for the Advancement of Science Award for Scientific Freedom and Responsibility in 2007; the Common Wealth Award for Distinguished Service in Science in 2008; both the Ohio State University’s Bownocker Medal and the Desert Research Institute’s Nevada Medal in 2008; the American Meteorological Society’s Carl-Gustaf Rossby Research Medal in 2009; and the Sophie Prize and the Blue Planet Prize in 2010.

OLA M. JOHANNESSEN, Founding Director, Nansen Environmental and Remote Sensing Center (NERSC), and Professor Emeritus, Geophysical Institute, University of Bergen, Norway

TITLE: *“Teleconnection between the Arctic Sea Ice Variations and Weather and Climate at Lower Latitudes”*

SUMMARY: Since 1979 the Arctic sea ice has declined dramatically (www.arctic-roos.org). Many published studies indicate that this loss of ice may impact the Polar Jet Stream, weather, and climate at lower latitudes and the monsoon system. We have investigated this problem by both analyzing variable data and global coupled models, finding that the spring Arctic sea ice variation can impact East Asian Summer Monsoon precipitation. Furthermore, we are now investigating how the projected ice-free Arctic summer in the future will or will not impact the Polar Jet Stream, weather, and climate in Europe.

BIO: Ola Johannessen, Founding Director of the Nansen Environmental and Remote Sensing Center in Bergen, Norway, is currently Senior Scientist and Nansen Fellow at the center. (www.nersc.no.) He leads the Nansen Group, which comprises six Nansen Centers in Norway, Russia, India, China, South Africa, and Bangladesh. He started, and is President of, the Nansen Scientific Society and Visiting Professor at the Institute of Atmospheric Physics at the Chinese Academy of Sciences. Johannessen is involved in the following scientific fields: Arctic climate system including sea-ice and Greenland ice-sheet variability, sea-level variation, Indian Ocean circulation, climate teleconnection between low and high latitude and vice versa including Arctic sea-ice variability impact on the East Asian Monsoon system and wintertime cyclone activity in China and its relationship to precipitation. At present Johannessen leads the Research Council of Norway (RCN), Arctic Sea Ice Variability, a comprehensive study using satellite and *in-situ* observations (Arctic SIV) 2010-13, the RCN Decadal-to-multi-decadal variability in the Indian Monsoon Rainfall and teleconnection with Atlantic Multi-decadal oscillation (India-Clim) 2012-2014, the RCN Climate variability and change in the Eurasian Arctic in the 21st century (NORRUSS) 2012-15 and the Mohn-Sverdrup Norwegian Sea and Greenland Ice Sheet projects. He is also the Chairman of the Steering Committee of two large European Union projects in India and Russia. He is the author and co-author of more than 600 publications of which 9 are books and 170 are in refereed journals, including 8 in *Science* and 1 in *Nature*. Johannessen has received 10 awards for his research and leadership. He was the Laureate of the European Union's Descartes Prize in Earth Science in 2005 for leading the project: Climate and Environmental Change in the Arctic. He received the Fridtjof Nansen Medal for Outstanding Research from the Norwegian Academy of Science in 2007. His Majesty King Harald V of Norway appointed him to the Royal Norwegian St. Olav's decoration, Knight of First Class, in 2008. In 2010 he was awarded honorary membership from the Norwegian Academy of Technological Sciences and received the “Certificate” from the Director-General of the European Space Agency for his contribution to the High-Level Science Policy Advisory Committee from 2007 to 2010. In 2011 he received The Norwegian Space Center award for his scientific contribution to increased international awareness and understanding of space activities—in particular for Earth

observations. Johannessen is a Council member in the Global Climate Forum, member of the editorial board of PRAXIS Publishing Ltd., Co-Chief Editor of the journal, *Atmospheric and Oceanic Science Letter*, of the Chinese Academy of Science and member of the editorial board of the *American Journal of Climate Change*. He was elected full member of the International Academy of Astronautics, the European Academy of Science and Arts, Finnish Academy of Science and Letters, the Norwegian Academy of Technical Sciences, the Norwegian Academy of Science and Letters, and the Norwegian Scientific Academy for Polar Research where he was the President from 2008 to 2012.

GERALD L. KOOYMAN, Professor Emeritus, Center for Marine Biotechnology and Biomedicine, Scripps Institution of Oceanography

TITLE: *“Rise and Fall of Emperor Penguin Colony Populations in the Ross Sea”*

SUMMARY: There are seven emperor penguin colonies distributed throughout the traditional boundaries of the Ross Sea, extending from Cape Roget to Cape Colbeck. The length of the coastline, including the Ross Ice Shelf, is about 10 percent of the coast of Antarctica. Perhaps the greatest concentrations of emperor penguins are found along this coastline. This is on the order of 60,000 breeding pairs. Over a 12-year period, from 2000 to 2012 (the census record extends back to 1983 but with gaps), there has been a nearly continuous record of population size of most, and sometimes all seven, of the Ross Sea emperor penguin colonies. Initially these data were collected from a mix of aerial photographs and ground counts. Since 2000, data have been obtained consistently by aerial photographs. In contrast to colonies elsewhere, there are large variations in sizes of individual colonies from year to year. In two sequential years the smallest colony of Cape Crozier has ranged from 1200 to 0 chicks fledged. The adult count of zero in 2001 at Cape Crozier was unprecedented, due to a cataclysmic iceberg event. In the last survey of 2012, however, Cape Washington, one of the largest colonies, produced only half the number of chicks that it did during the 1990s, while Cape Colbeck had more than twice the number of chicks that it did in 1994. In summary, our earlier conclusion from a 2007 report, “Ultimately, we expect emperor penguin populations are most responsive to local sea-ice conditions in the molt area, and at the colony,” remains valid. The emperor penguin may not be a good environmental sentinel, as has been argued. Emperor penguins are not bound to a colony nesting site like other penguins, but move about. There are at least three possibilities for census count fluctuations: 1) Harsh times cause a die-off of chicks in the colony or of adults elsewhere; 2) they emigrate; 3) the adults skip a year of breeding. Importantly, such variability indicates that all these colonies should be sampled annually if there is any possibility of understanding the status and the most important environmental factors regulating the colony sizes.

BIO: Gerald Kooyman, a leading authority on the emperor penguin, is a research physiologist at

the Center for Marine Biotechnology at Scripps Institution of Oceanography. Having received his B.A. degree from the University of California, Los Angeles, he undertook graduate work at UC Berkeley and Stanford, obtaining his Ph.D., from the University of Arizona in 1966 studying the physiological and behavioral characteristics of Weddell seals in McMurdo Sound, Antarctica. As part of this work he designed the first time/depth recorder ever attached on a marine animal, which showed that Weddell seals dive to depths as great as 600 meters and can remain submerged for more than one hour—capacities that far exceeded previous estimates. The natural history of free-ranging marine higher vertebrates has been a central theme of his research ever since. Under an NSF postdoctoral fellowship, he spent a year at the London Medical College studying marine mammal lungs to learn why marine mammals do not get “the bends” while deep diving. Subsequently he joined a group of comparative physiologists at the Physiological Research Laboratory of Scripps, conducting research on asphyxia defense in marine mammals. He has led or participated in more than 50 expeditions to the Antarctic and various other parts of the world. Currently most of his research effort is directed toward the biology of emperor penguins throughout the boundaries of the Ross Sea, focusing on their foraging ecology through the seasons from breeding and nurturing their single chick to their departure from the colony and distribution during and after the molt cycle. This coverage incorporates their exposure to many different sea-ice conditions and prey distribution. Concurrently his team is using aerial and satellite imagery to determine the population status of the seven colonies of the Ross Sea. The collection of this time series ended in 2012. The hope is that foraging and distribution studies of emperor penguins will continue during the fall and winter of 2016-17. Kooyman has published roughly 200 papers dealing mainly with marine tetrapods. He is the author of three books, among them *Diverse Divers: Behavior and Physiology* (Springer-Verlag, 1989) and *Weddell Seal: Consummate Diver* (Cambridge University Press, 2009). His first co-edited book, *Fur Seals: Maternal Strategies on Land and at Sea* and originally published in 1986, is available in paperback (Princeton Legacy Library). In 1966 he was honored with a Geographic Name, Kooyman Peak, Queen Elizabeth Range, Antarctica. He is a member of the Marine Mammal Society, earning the first Kenneth Norris Life Time Achievement Award in 2005; a Fellow of The Explorers Club, receiving its Quadrennial Finn Ronne award in 2007; and a member of the American Physiological Society, which honored him with the August Krogh Distinguished Lectureship in 2011.

MARGARET LEINEN, Director, Scripps Institution of Oceanography, and President, American Geophysical Union

BIO: Margaret Leinen, an award-winning oceanographer and academic leader, was appointed the eleventh director of Scripps Institution of Oceanography in July 2013. She simultaneously serves as UC San Diego’s vice chancellor for marine sciences and dean of its School of Marine Sciences. Leinen has extensive national and international experience in ocean science, global climate and environmental issues, federal research administration, and nonprofit groups. A

researcher in paleo-oceanography and paleo-climatology, her work focuses on ocean sediments and their relationship to global biogeochemical cycles and the history of Earth's ocean and climate. She received her bachelor's degree in geology from Oregon State University in 1969, her master's degree in geological oceanography from the University of Illinois in 1969, and her doctorate in oceanography from the University of Rhode Island in 1980, where she was Vice Provost for Marine and Environmental Programs and Dean of the Graduate School of Oceanography. Currently she leads UC San Diego's ocean, earth, and atmospheric sciences research and education programs at Scripps, as they address the most pressing environmental problems facing our planet, and teaches the next generation of science leaders. Prior to joining Scripps, she was Vice Provost for Marine and Environmental Initiatives and Executive Director of Harbor Branch Oceanographic Institute, a unit of Florida Atlantic University. Before that she served for seven years at the National Science Foundation (NSF) as Assistant Director for Geosciences and Coordinator of Environmental Research and Education, where she oversaw a budget of \$700 million, led government-wide planning for climate research, and co-led government planning for ocean research. While at NSF, she presided over and directly influenced some of the most consequential programs in marine, atmospheric, and earth science. She is the founder and past president of the Climate Response Fund, a nonprofit organization that works to foster discussion of climate engineering research and to decrease the risk that these techniques might be called on or deployed before they are adequately understood and regulated. Previously, she spent two years as the Chief Science Officer of Climos, Inc., a startup focused on green technology for climate mitigation. She is President of the American Geophysical Union, past chair of the Atmospheric and Hydrographic Science Section of the American Academy for the Advancement of Science, and past president of The Oceanography Society. She is on the board of the National Council for Science and the Environment and previously served on the National Ecological Observatory Network. Additionally she served as Vice Chair of the International Geosphere-Biosphere Programme and on the board of Global Change of the National Research Council/National Academy of Sciences. She is Vice Chair of the Research Board of the \$500-million Gulf of Mexico Research Initiative. Leinen has received Distinguished Alumni Awards from all three universities she attended as a student.

ALFRED S. MCLAREN, President, American Polar Society, President Emeritus, The Explorers Club

BIO: Captain Alfred Scott McLaren, USN (Ret.), is President of the American Polar Society and President Emeritus of the famed Explorers Club, a "Global Perspectives Lecturer" for Lindblad/National Geographic, author and former research scientist who has conducted longitudinal study of the decreasing thickness of the Arctic ice pack. As a career nuclear attack submarine officer, he took part in three Arctic expeditions for the U.S. Navy: the first submerged transit of the Northwest Passage, a Davis Strait expedition, and, as Commander of USS *Queenfish* (SSN-651), a North Pole expedition that completed the first survey of the entire Siberian Continental Shelf.

He is a former Commanding Officer of the Naval Underwater Systems Center, Newport, R.I., a Director of the Institute of Nautical Archeology at Texas A&M University and a former research and teaching professor at the University of Colorado and the Lamont-Doherty Earth Observatory at Columbia University. From 1991 to 1996 he served as president of Science Services, Inc., and publisher of its weekly magazine *Science News*. A graduate of the U.S. Naval Academy in 1955 and the U.S. Naval War College in 1968, McLaren was among the first 50 selected by Admiral Hyman G. Rickover to undergo nuclear power training. He was awarded an M.S. in international affairs from George Washington University in 1968, an M.Phil. in polar studies from the University of Cambridge (Peterhouse) in 1982, and his Ph.D. in the physical geography of the polar regions is from the University of Colorado in 1986. Honors include The Explorers Club's Lowell Thomas Medal for Ocean Exploration in 2000 and its highest honor, The Explorers Club Medal in 2012 for "His extraordinary contributions to Arctic exploration and deep sea research, including the first survey of the entire Siberian Continental Shelf." He has also received the *Société de Géographie de Paris* Silver Medal and *La Médaille de la Ville De Paris (Echelon Argent)* for Polar exploration. His awards as a Cold War submarine commander include the Distinguished Service Medal (the nation's highest peacetime award), two Legions of Merit, the Meritorious Service Medal, the Navy Commendation Medal, and four Navy Unit Commendations. Turned deep-sea explorer, he has completed manned dives to the *RMS Titanic* and the Mid-Atlantic Ridge hydrothermal vents and undertook the first manned dives to the German battleship *Bismarck*. In February 2003 he became the first deep-sea explorer to be licensed as a "Pilot in Command" of Graham Hawkes' new high-performance submersible, *Deep Flight Aviator*. He is the author or co-author of more than 50 refereed scientific articles. His first book, *Unknown Waters: A First-Hand Account of the Historic Under-Ice Survey of the Siberian Continental Shelf by USS Queenfish (SSN-651)* (University of Alabama Press, 2008), was judged a "Notable Naval Book of 2008" by the U.S. Naval Institute. His second book, *Silent and Unseen: On Patrol in Three Cold War Attack Submarines* (U.S. Naval Institute Press, 2015), was released in May 2015. He is a Fellow of the Arctic Institute of North America.

WALTER H. MUNK, Emeritus Professor of Geophysics, Holder of the Secretary of the Navy/Chief of Naval Operations Oceanography Chair, Scripps Institution of Oceanography

TITLE: "*Climate and the Gulf Stream*"

SUMMARY: The global ocean circulation is dominated by five giant subtropical gyres: the Gulf Stream system in the North Atlantic, the Kuroshio and California Currents in the North Pacific, and similar features in the South Atlantic, South Pacific and Indian Oceans. They are driven by wind torque, the east-to-west trade winds on the equatorial side, and the polar westerlies. In each of the gyres the currents are intensified on the western side (on the eastern shores of the land boundaries). The western intensification is the result of the rotation of the Earth (the so-called Coriolis Force). If the Earth rotated in the opposite direction, we would have a Gulf Stream on

California Shores. The intensity is measured in Sverdrup's: One Sverdrup is one million cubic meters per second of transport. The Atlantic Gulf Stream gyre varies between 20 and 50 Sverdrups. Given the wind torque, the gyre transport can be calculated from a theory by Sverdrup and Stommel. To a first order, wind torque depends on the difference between temperatures at the equatorial and polar boundaries. There seems to be agreement that there will be warming at both boundaries but that the polar sides will warm more; the temperature difference will diminish and so will the general circulation. Changes in circulation have multiple causes. The present change is the result of increased human carbon consumption and attendant CO₂ release causing a radiation imbalance and temperature rise. A similar sequence has been observed following massive volcanic events. Ice ages are caused by perturbations in the radius, distance and tilt of the plane of the Earth's orbit around the Sun. They occur at roughly 100,000-year intervals. Here the release of CO₂ is secondary and follows the perturbation in heating, as demonstrated by Jeff Severinghaus from the isotopic composition in dated air bubbles (order 1 million years) in Antarctic ice cores. We are now moving toward the coming ice age in 20,000 years. Today there is increased concern about a possible acceleration in the melting of Greenland glaciers associated with melting of the floating polar ice sheet and the inevitable increase in albedo.

BIO: Walter Munk is a physical oceanographer who has made significant contributions to our understanding of waves, currents, tides, and the formation of the Earth and Moon systems. Born in Austria, he joined the Scripps Institution of Oceanography in 1939, spending his entire professional life there. He has held the Secretary of the Navy Oceanography Chair in Oceanography at Scripps for more than 32 years. His early research, together with Harold Sverdrup, on wave predictions in World War II led to the first successful Allied offensive of the war and was ultimately used for the landings in Normandy on D Day. His current work focuses on climate change and sea-level rise related to their severe impact on humankind. Munk received a Ph.D. in oceanography from Scripps in 1947, becoming assistant professor and then, in 1954, full professor of geophysics, also named a member of the University of California's Institute of Geophysics. On the Scripps campus in 1960, he established a branch of the university-wide Institute, serving as branch director and then as associate director of the institute as a whole (since renamed the Institute of Geophysics and Planetary Physics). In 1983 he won the National Medal of Science and, in 1999, the Kyoto Prize in Basic Sciences for his fundamental contributions to the field of oceanography. In 2001 he was the inaugural recipient of the Prince Albert Medal in the physical sciences of the oceans, created by Prince Rainier of Monaco in cooperation with the International Association for the Physical Sciences of the Oceans. His other honors include the Craford Prize of the Royal Academy of Sciences, awarded in 2010 in recognition of his pioneering and fundamental contributions to human understanding of ocean circulation, tides and waves, and their role in the Earth's dynamics (the first researcher from Scripps to win the prize). He received the Roger Revelle Medal "in honor of his achievements and impact advancing the UC San Diego mission" in 2013 (the medal had not been awarded in more than a decade.) and the Explorers Medal, the top honor of the Explorers Club, in 2014.

CLAIRE L. PARKINSON, Climate Change Senior Scientist, National Aeronautics and Space Administration (NASA)

TITLE: *“Satellite-Observed Changes in Arctic and Antarctic Sea Ice, Placed in the Broader Context of Climate Change”*

SUMMARY: With its high reflectivity and strong insulating capabilities, sea ice has been an important component of the Arctic and Antarctic regions at least since the last interglacial over 115,000 years ago. For most of that period, the observational record of sea ice is almost non-existent, but since the late 1970s, due to satellite passive-microwave instrumentation, sea-ice distribution has become among the best observed of all climate variables. The satellite record reveals considerable inter-annual variability in the sea-ice distributions but also clear trends, and this is true of both polar regions. Arctic sea-ice extent has decreased significantly over the course of the satellite record, with a trend in monthly deviations for November 1978-December 2014 of approximately $-53,000 \pm 1,800 \text{ km}^2/\text{yr}$, solidly in line with an array of other changes in the Arctic, including warming temperatures, decreasing land-ice coverage, and, for some plant life, a lengthened growing season. Antarctic sea-ice extent has instead increased over the same period, although at the much lesser rate of about $22,300 \pm 2,100 \text{ km}^2/\text{yr}$ and with sharp regional contrasts, some of which could well be connected to changes in atmospheric circulation. Accompanying the ice-extent changes are corresponding changes in such variables as the length of the sea-ice season and the onset of melt, also obtainable from satellite data. Although satellites have not yet provided long-term climate data records of sea-ice thickness, satellite-based laser and radar altimeters have shown great promise that eventually ice-thickness climate data records will also be available.

BIO: Claire Parkinson is a climate scientist at NASA’s Goddard Space Flight Center, where she has worked since 1978. Her research emphasis has been on polar sea ice and its connections to the rest of the climate system and to climate change, with a particular emphasis on satellite remote sensing. This work has involved satellite data-set generation and analysis, including the determination of decreases in Arctic sea-ice coverage since the 1970s and examination of their regional variabilities and impacts. Since 1993 she has been Project Scientist for the Aqua satellite mission, which launched in May 2002 and which is transiting data on many atmospheric, ocean, land, and ice variables. She received a B.A. in mathematics from Wellesley College with highest honors in 1970, an M.A. in geography/climatology from Ohio State University in 1974, and a Ph.D. in geography/climatology from The Ohio State University in 1977. Parkinson is the author or co-author of more than 98 refereed and 14 nonrefereed scientific articles. She has written books on satellite Earth observations and climate change or has co-written/co-edited books on sea ice, climate modeling, satellite data, and the careers of women at Goddard. Her 2010 book, *Coming Climate Crisis? Consider the Past, Beware the Big Fix* (Rowman & Littlefield), concerns the possibility of implementing potentially dangerous geoengineering projects in dealing with climate change. Outside of her NASA work, she has written a book on the history of

Western science from 1202 to 1930. Parkinson is a member of the National Academy of Engineering (NAE), the American Philosophical Society (APS), and Phi Beta Kappa. She has served on the Council of the American Association for the Advancement of Science (AAAS) and on committees of the NAE, APS, AAAS, and American Meteorological Society (AMS), among many other professional bodies. A Fellow of both the AAAS and the AMS, she is the first female recipient of the Richard P. Goldthwait Polar Medal from the Byrd Polar Research Center at The Ohio State University. Previously she was awarded the NASA Outstanding Leadership Medal, the AMS Remote Sensing Prize, and the NASA Exceptional Achievement medal.

TED A. SCAMBOS, Senior Research Scientist, National Snow and Ice Data Center (NSIDC), University of Colorado

TITLE: *“The Ongoing Evolution of the Larsen Ice Shelf”*

SUMMARY: Ocean warming and a change in regional wind patterns have conspired to cause the disintegration of several major areas of the Antarctic Peninsula through a complex interaction of weather changes, surface melting, changing ocean currents, and basal thinning of the ice shelves.

BIO: Ted Scambos is a glaciologist, senior research scientist, and lead scientist for the National Snow and Ice Data Center science team, specializing in satellite data of the polar ice caps and the effects of climate change in Antarctica. Among his research interests are climate change effects on the cryosphere, Antarctic history, geochemistry and planetary science. He has studied the collapse of ice shelf areas and glacier acceleration in the Antarctic Peninsula, ice streams of the Ross Ice Shelf, and wind-snow interactions on the East Antarctic Plateau, in 17 expeditions to Antarctica. A major focus of his work now is developing instrumentation to try to better monitor and understand Antarctic climate and ocean circulation in areas of major change. He holds a masters degree from Virginia Polytechnic Institute and State University and a doctorate in geology from the University of Colorado at Boulder (1991). His interest in satellite data began when he used Landsat imagery for his Ph.D. thesis. Prior to coming to NSIDC, he worked at NASA’s Goddard Space Flight Center studying Antarctica using satellite data. As lead scientist at NSIDC, he has conducted nine field studies of the West Antarctic ice sheet and its sea ice, and several remote sensing of West Antarctic ice shelves with colleagues Christina Hulbe of Portland State University and Mark Fahnestock of the University of Maryland. His remote sensing research concentrates on visible and near-IR remote sensing, ICESat laser elevations, field GPS, and ice profiling radar studies. Recent work had taken him from unique large dune features in the center of the East Antarctic Plateau (“megadunes”) to the icebergs off the shore of the Antarctic Peninsula and south of Argentina. He was part of an international team that landed on an Antarctic iceberg to set up observational instruments for detecting changes as the iceberg drifts north and begins to melt. He is the author or co-author of more than 85 scientific articles.

LYNNE D. TALLEY, Distinguished Professor of Oceanography, Scripps Institution of Oceanography, and Co-director, Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM)

TITLE: *“Southern Ocean Role in the Global Overturning Circulation and Climate Change”*

SUMMARY: All of the deep waters of the global ocean upwell to the sea surface in the Southern Ocean, where they split and are transformed to both the densest bottom waters and to upper ocean waters in the subtropical Southern Hemisphere. This affects heat and carbon exchange globally between the atmosphere and ocean. The upwelled deep waters warm the Antarctic ice shelves and contribute to their underwater melting. The upwelled deep waters also affect the Southern Hemisphere’s sea-ice extent, which has been subject to a slight increase in comparison with the Arctic’s large sea ice reduction over the past decade in response to climate change.

BIO: Lynne Talley is a professor of physical oceanography in the Climate, Atmospheric Sciences, and Physical Oceanography division at Scripps Institution of Oceanography. Her research focuses on the general circulation of the ocean and the role of various oceanic and atmospheric conditions that affect ocean currents and property distributions, including salinity. Her work involves analysis of data from most of the world’s oceans, depicting the movement of heat, salinity, and water masses and the formation of water masses. She received a B.A. degree in physics and a B.M. in piano performance from Oberlin College in 1976, and a Ph.D. in physical oceanography from the Massachusetts Institute of Technology-Woods Hole Oceanographic Institution in 1982. Prior to joining Scripps in 1984, Talley was a postdoctoral researcher at Oregon State University in Corvallis. At Scripps her research has combined analysis of ocean observations with advanced theoretical work to describe and map large-scale circulation. Talley has been chief scientist on numerous cruises worldwide, collecting data aboard research ships. She currently heads the observational portion of SOCCOM, the National Science Foundation-sponsored project that is deploying biogeochemical floats throughout the oceans around Antarctica to study their role in the global carbon cycle and hence climate change. She is co-leader of the U.S. contribution to the GO-SHIP decadal resurvey of the global oceans. She also conducts research in the Indian Ocean. A lead author of the Intergovernmental Panel on Climate Change Fourth and Fifth Assessment Reports’ Working Group I chapters on ocean observations, Talley has been an author on numerous reports of the National Academy of Sciences. She is first author of one of the principal textbooks used for graduate instruction in physical oceanography. Current president of the Ocean Sciences section of the American Geophysical Union, Talley received the Rosenstiel Award from the University of Miami’s Rosenstiel School of Marine and Atmospheric Science in 2001 and the Huntsman Award from the Bedford Institute of Oceanography in 2003. She was elected a fellow of the American Academy of Arts and Sciences

in 2003, a fellow of the American Geophysical Union in 2006, a fellow of the American Meteorological Society in 2008, and a fellow of the Oceanography Society in 2010.

DAVID L. VANDERZWAAG, Professor of Law and the Canada Research Chair (Tier 1) in Ocean Law and Governance, Dalhousie University, Halifax, Nova Scotia

TITLE: “*Climate Change and Ocean Governance in the Arctic: Conflict, Cooperation and Challenges*”

SUMMARY: In the wake of decreasing ice cover, the opening of new shipping routes and increasing access to vast mineral resources in the Arctic, the adequacy of existing governance arrangements relevant to the region has become a “hot topic.” This presentation will provide a three-part “speed cruise” through the international law and policy seascape governing the fast-changing Arctic. Highlighted will be, first, territorial and jurisdictional conflicts, including the continuing disputes between Canada and the United States over the legal status of the Northwest Passage and the location of the ocean boundary in the Beaufort Sea; second, the numerous avenues of international cooperation including the central role of the Arctic Council; adoption of a new Polar Shipping Code, and global efforts to control the long-range transport of persistent organic pollutants and mercury into the Arctic; and third, sea of governance challenges such as the need, a) to enhance future governance arrangements in the central Arctic Ocean beyond national jurisdiction; b) to put the ecosystem approach into practice; c) to address the many limitations of the Arctic Council, such as lack of secure funding and limited accountability; and d) to bolster vessel routing measures in Arctic waters to protect ecologically and culturally significant areas.

BIO: David VanderZwaag is Professor of Law and the Canada Research Chair (Tier 1) in Ocean Law and Governance at Dalhousie University, Halifax. He teaches international environmental law and is the past Co-director of Dalhousie's interdisciplinary Marine Affairs Program (1986-1991) and the past Director of the Marine & Environmental Law Institute. He is currently a member of the International Union for the Conservation of Nature's World Commission on Environmental Law (WCEL) and Co-chair of WCEL's Specialist Group on Oceans, Coasts & Coral Reefs. He is an elected member of the International Council of Environmental Law. VanderZwaag has authored more than 150 papers in the field of marine and environmental law. He has written widely on polar law and policy issues, including co-leading the writing of the “Governance of Arctic Shipping” chapter of the *Arctic Marine Shipping Assessment Report 2009* (Arctic Council) and co-editing *The Challenge of Arctic Shipping: Science, Environmental Assessment and Human Values* (Montreal & Kingston: McGill-Queen's University Press, 1990) and *Transit Management of the Northwest Passage: Problems and Prospects* (Cambridge: Cambridge University Press, 1988, reprinted 2008). His most recent book is *Polar Oceans Governance in an Era of Environmental Change* (edited with Tim Stephens) (Cheltenham, UK: Edward Elgar 2014). He continues to serve as regional reporter on the Arctic for the *Yearbook of*

International Environmental Law. VanderZwaag received a B.A. from Calvin College in 1971, M.Div. from Princeton Theological Seminary in 1974, J.D. from the University of Arkansas Law School in 1980, an LL.M. from Dalhousie Law School in 1982, and a Ph.D. from the University of Wales, Cardiff, in 1994).

JOHN E. WALSH, Chief Scientist and President's Professor Global Change, International Arctic Research Center, University of Alaska Fairbanks

TITLE: *"The Historical Sea-Ice Record for the U.S. Maritime Arctic"*

SUMMARY: Coastal and offshore activities in the U.S. maritime Arctic have long been affected by sea-ice variations. Examples include the whaling industry in the late 1800s, coastal communities subject to storm-induced flooding and erosion, and, during the past 50 years, the oil and gas industry. The extreme retreat of sea ice in the summer and autumn of the past decade is well documented by the satellite record and by the reality of longer open-water seasons along the Alaskan coasts. Walsh will present a synthesis of historical sea-ice information back to 1850 in order to place the recent sea-ice loss into a longer-term context, addressing the potential role of natural variability in the recent sea ice loss. The observed natural variability, together with that deduced from global climate models, will be summarized with an eye toward such questions as: What are the chances that Arctic sea-ice coverage could increase over the next decade or two? The talk will also touch on the importance of seasonality when considering sea-ice trends, as winter and summer show impressive contrasts both in historical data and in projections for the future.

BIO: John Walsh is Chief Scientist of the International Arctic Research Center at the University of Alaska Fairbanks. His research has addressed the variability of sea ice, climate, and weather and the interactions among them. He is particularly interested in the drivers of sea-ice variability, including the recent reduction of summer sea ice in the Arctic and its uniqueness in the longer historical record. His work extends to the impacts of sea ice, climate and weather on Alaska, where he co-leads the Alaska Center for Climate Assessment and Policy. Walsh was a lead author for the Polar Regions chapter of the Fourth Assessment Report (2004-2007) of the Intergovernmental Panel on Climate Change; lead author of the snow/ice/hydrology chapter of the Arctic Climate Impact Assessment (Arctic Council), and a convening lead author for the third U.S. National Climate Assessment, *Climate Change Impacts in the United States* (1914). Before joining the University of Alaska, he spent 30 years on the faculty of the University of Illinois, Urbana, where he taught courses on weather and climate. He holds a B.A degree in mathematics and computer science from Dartmouth College and a Ph.D., from the Massachusetts Institute of Technology. Walsh is co-author with Robert Rauber and Donna Charlevoix of the textbook, *Severe and Hazardous Weather: An Introduction to High Impact Meteorology* (third edition). In press is *Variability of Sea Ice over Decadal and Longer Time Scales* (Polar Geography), co-authored with W. L. Chapman. He is editor of the *Journal of Climate*, a Fellow of the American

Association for the Advancement of Science, and a Fellow of the American Meteorological Society.

CORPORATE SPONSORS

CLERC WATCHES

The American Polar Society is privileged and excited to join hands in this endeavor with a corporate sponsor that uniquely revamped its business model to engage in advocacy and tangible support of the environment—specifically, the vast oceans that cover 70 percent of the Earth’s surface. CLERC (www.clercwatches.com), the historic and famed Swiss watchmaker whose contemporary line of luxury dive watches makes it a stand-alone leader in the competitive field of high-end timewear, has launched an international program called the “Openwater Heroes Ocean Conservancy Initiative.”

CLERC’S Chief Executive Officer Gerald Clerc, himself a certified scuba diver, recently announced the inauguration of the Openwater Heroes Ocean Conservancy Initiative and embraces the conviction that the oceans are being threatened by industrialization, consumption, and energy exploration. Moreover, he believes that the life they contain is a gift to all mankind and deserves protection and preservation. CLERC strives to give back to the oceans for the inspiration it provided their designers and engineers, and from this sense of connectivity came the idea of the Openwater Heroes.

Each year, or as circumstances warrant, CLERC—through Openwater Heroes—will promote significant ocean causes and the selfless heroes who too often remain unknown and uncelebrated. The American Polar Society, with its focus on the polar oceans, fits this template with ease and welcomes with gratitude the interest and support extended by this corporate citizen of the world.

The foregoing sketch of CLERC’s involvement in ocean conservancy offers but a glimpse of the depth and breadth of their corporate vision in, under, and over the oceans of the world. Go to <https://www.facebook.com/openwaterheroes>, for example, and find their relationship with Sub Aviator Systems. Or, jump straight to Sub Aviators Systems’ homepage (<http://www.subaviators.com>) and read about their partnership with CLERC.

ADVENTURE CANADA

Adventure Canada is a family-run expedition travel company with over twenty-five years’ experience in small-ship and land-based tours to the Canadian Arctic and east coast, Greenland, and beyond. Its pioneering itineraries include visits to some of Canada’s wildest and most remote

destinations and feature stunning landscapes, incredible wildlife, and unforgettable culture. With a resource team comprising the best and brightest of Canada's science, arts, and cultural communities and their firm commitment to community involvement and environmental stewardship, Adventure Canada prides itself on occupying the point of intersection between exploration, learning, and fun.

THE AMERICAN POLAR SOCIETY

The American Polar society (APS) is the only organization linking scientists, explorers and enthusiasts around the world who value the uniqueness of the polar regions and play critical roles in shaping their destiny. For nearly 80 years, through a journal, *The Polar Times*, and a series of symposiums, the APS has kept a select community updated on scientific, diplomatic, literary, and economic trends and developments in the Arctic and Antarctic. With the polar regions having become central to the study of climate change and increasingly strategic in the modern world, the APS is developing new and timely initiatives. Its most recent symposium, held April 15-18, 2013, at the Marine Biological Laboratory, Woods Hole, Massachusetts, addressed "The Polar Regions in the 21st Century: Globalization, Climate Change, and Geopolitics."

Founded in 1934, the APS emerged out of widespread public interest in the polar regions aroused by the Byrd Antarctic expeditions in the early part of the last century. Its first president was Paul Siple, who sailed as a member of the first and second Byrd expeditions at the outset of a distinguished scientific career. In addition to Admiral Richard E. Byrd, such polar luminaries as Sir Hubert Wilkins, Lincoln Ellsworth, Louise Arner Boyd, and General David Brainard have been members. Its current president is Captain Alfred S. McLaren USN (Ret.), Ph.D., a former Cold War nuclear submarine commander and a research scientist. He is a President Emeritus of The Explorers Club (1996-2000).

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Based in La Jolla, California, Scripps is one of the largest and oldest research centers for global science research and education in the world. Scripps' educational mission is to train its students to perform cutting-edge research and to apply and communicate scientific knowledge for the benefit of society and the environment. Scripps was founded in 1903 and became part of the UC San Diego in 1960. The scientific scope of the institution has grown to embrace biological, physical, chemical, geological, and geophysical studies of the oceans, earth, and atmosphere. Among the hundreds of research programs are studies of air-sea interaction, climate prediction, ocean dynamics, earthquakes and Earth structure, the physiology, ecology, and genetics of marine organisms, marine chemistry, beach erosion, coastal pollution, coral reefs, the marine

food chain, the geological history of the ocean basins, and many multidisciplinary aspects of global change, conservation, and the environment. Observation, measurement, and the collections of specimens and data are accomplished by shipboard, ground, and aerial operations, including remote-sensing by satellite.

Scripps currently employs 235 professors and researchers and maintains two research vessels with another (*R/V Sally Ride*) under construction. Scripps' personnel have included three Nobel Prize winners, eighteen members of the National Academy of Sciences, and two members of the National Academy of Engineering. Its annual research budget now approaches \$200 million from federal, state, and private sources. UC San Diego is unique in having a public aquarium and science center on campus. Birch Aquarium at Scripps provides ocean and earth sciences educational experiences for K-16 students and the public, and outreach opportunities for UC San Diego faculty, researchers, and graduate/undergraduate students.

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